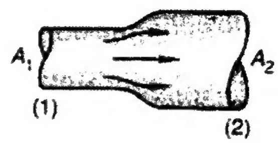
Bernoulli's Principle

Bernoulli's Equation

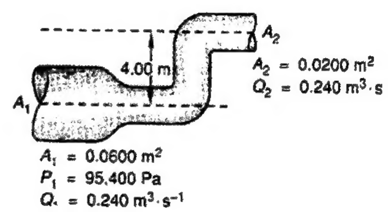
$$P + \frac{1}{2}\rho v^2 + \rho g h = \text{constant}$$

This equation tells us that at any point along a frictionless pipe in which an ideal fluid flows the sum of (a) the pressure P, (b) the kinetic energy per unit volume $\frac{1}{2}\rho v^2$, and (c) the potential energy per unit volume $\rho g h$ is a constant.

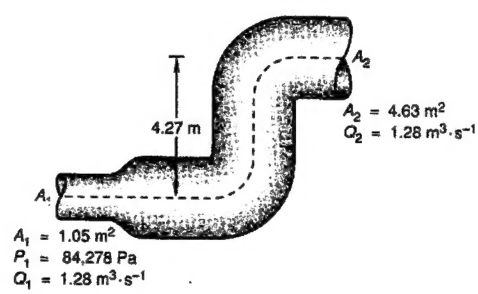
1) Water whose density is 1000 $kg \cdot m^{-3}$ flows through a pipe with a flow rate of 0.800 cubic meter per second. The area of the pipe at (1) is 0.250 m^2 and the pressure is 5.20 pascals. The area of the pipe at (2) is 0.400 m^2. What is the pressure at (2)?



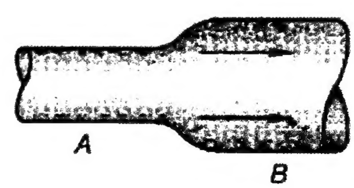
2) Ethyl alcohol (806 kg per cubic meter) has a flow rate of 0.240 cubic meter per second through a pipe whose area is 0.0600 square meter and in which the pressure is 95,400 pascals. The centerline of the pipe rises 4.00 meters and the area is reduced to 0.0200 square meter. What is the pressure now?



3) Water flows through the pipe shown. The pressure in the larger pipe is $7.0 \times 10^5\ N \cdot m^{-2}$ and the speed in the larger pipe is 1.2 m/s. (a) Use the flow rate equation to find the water speed in the smaller pipe if A_{large} = 4.0 m^2 and A_{small} = 1.0 m^2. (b) Use Bernoulli's equation to find the pressure in the smaller pipe.

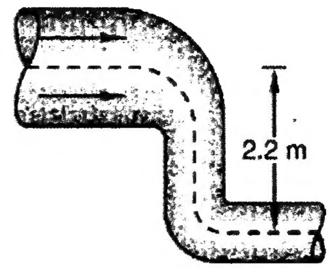


4) Water that has a density of 1010 kg/m^3 flows through a pipe with a laminar flow rate of 3.9418 cubic meters per second. The area of the pipe at A is 2.2006 m^2 and the pressure is 4480 pascals. The area of the pipe at B is 4 m^2. What is the pressure at B?



Bernoulli's Principle

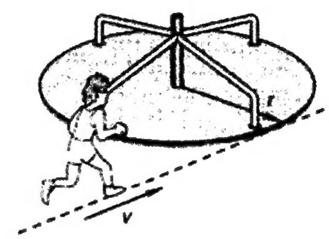
5) Gasoline that has a density of 670 kg/m^3 has a flow rate of 0.25 cubic meter per second through a pipe whose area is 0.40 square meter and in which the pressure is 31,051 pascals. The centerline of the pipe drops 2.2 meters and the area is decreased to 0.20 square meter. What is the pressure now?



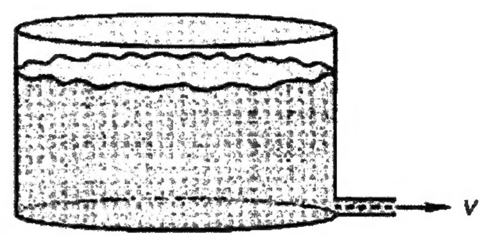
6) Explain why the stream of water from a faucet becomes narrower as it falls.

7) You have two eggs. One is hard-boiled, and one is uncooked. When you spin both of them on a table, you can tell one is hard-boiled, and one isn't. Explain.

8) A 30.0-kilogram boy runs at 3 meters per second on a path that is tangential to a circular merry-go-round which is not moving. The merry-go-round is frictionless and has a moment of inertia of 480 kilogram-meters squared and a radius of 2 meters. Find the angular speed ω after the boy jumps aboard.



9) The city water tank is being emptied for inspection. The tank has a cross-sectional area of 40 m^2, and the output pipe has a cross-sectional area of 0.10 m^2. Assume the water pressure in the pipe is 1 atmosphere. Find the speed of water leaving the drainpipe when the water level in the tank is dropping at 5×10^{-3} m/s.



10) A flywheel with a homogeneous mass of 12 kg, a radius of 0.10 m, and a moment of inertia of $\frac{1}{2}mr^2$ is spinning with an angular speed of 68 rad/s. A 2.0-kg clutch with a moment of inertia of 3.2×10^{-3} kg$\cdot$m^2 and an initial angular momentum of zero latches onto the flywheel. Angular momentum is conserved. (a) Find the new angular speed. (b) Find the total kinetic energy.